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Flipped Classroom Use in Veterinary Education: A multinational survey of faculty experiences

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Abstract

Active teaching approaches such as the flipped classroom are linked to better quality student learning outcomes across healthcare disciplines, with the potential to support students' preparedness for practice. In the flipped classroom instructional approach, students engage in significant pre-class preparation to learn foundational knowledge and skills, then undertake instructional activities in the classroom which require them to integrate, apply and extend their learning to new contexts. This study reports the results of a multinational survey of flipped classroom use in veterinary education. Participants' ($n = 165$) familiarity with and extent of use of the flipped classroom technique were investigated, together with the teaching strategies used and the perceived benefits and barriers to implementation. Relationships between respondent characteristics and flipped classroom use were also explored. The results indicated that 95% of participants were familiar with the flipped classroom technique, although fewer (64%) used it in their teaching. Pre-class activities included reviewing online and printed material, and engaging in preparatory learning activities such as quizzes, case analyses, reflective assignments and group activities. A variety of active learning strategies were used in class, including discussions, presentations, quizzes, group activities, problem-solving and laboratory/practical exercises. Most participants perceived that the flipped classroom technique benefited student learning, with some also identifying benefits for the faculty involved. A range of student-, faculty- and institution-related barriers to implementing the flipped classroom technique were identified. These barriers need to be addressed by teachers and administrators seeking to improve students' preparedness for practice by implementing flipped classrooms in veterinary education.

Key words

Flipped classroom, veterinary education, instructional technology, team-based learning

Introduction

Preparing students for the range of careers that veterinarians can fulfil requires actively engaging them in implementing knowledge and skills throughout the veterinary degree program. Research in a variety of disciplines shows that improved learning outcomes result when learning activities are meaningful for the workplace (including working in groups and addressing real-world problems) and provide useful feedback.¹⁻⁷ A recent meta-analysis in university-level science, technology, engineering and mathematics (STEM) instruction illustrated that adopting innovative teaching approaches that engage students more actively than traditional lecture-based approaches results overwhelmingly in improved learning outcomes, with an average effect size (weighted standardized mean difference) of 0.47.⁸ These studies suggest that incorporating active learning techniques in veterinary education may improve students' preparedness for success in their chosen career.

One way of achieving this goal is by implementing the flipped classroom technique. This instructional approach is one where students engage in significant pre-class preparation to learn foundational knowledge and skills, then undertake learning activities in class which require them to integrate, apply and extend their knowledge and skills.⁹⁻¹² This reverses the traditional model of teaching where 'learning' – meaning transfer of information – is intended to occur during class and 'homework' – where students grapple with application of the material – occurs out of class. The use of online technologies such as videos and podcasts have become synonymous with the phrase 'flipped classroom' in recent years.¹³ However, this teaching method is not new. Good teachers have been using a flipped classroom technique for hundreds of years, with preparatory activities involving reading textbook chapters, printed journal articles or study notes prior to class.¹⁴

Use of the flipped classroom technique is well established in education at all levels, including primary, secondary and higher education.^{9,15,16} In healthcare education, use of the flipped classroom

technique has been reported in cardiology and respiratory physiology¹⁷, nursing^{12,13}, pharmacology^{18,19} and gross anatomy²⁰ courses. Fatmi et al.²¹ reported 330 studies describing implementations of Team Based Learning (TBL), a specific application of the flipped classroom approach, across many sub-disciplines of healthcare education. Preparatory activities used in healthcare education include watching specially prepared or publically available online videos and podcasts, and reading online journal articles and textbook chapters.¹³ Often times, a formative assessment is implemented either before or at the start of the class to test student preparation. Common activities during class include short review sessions to address lingering misconceptions, especially those that have been revealed through the answers to preparatory quiz questions, and extending the students' understanding of relational concepts based on the foundational pre-work, small group discussion, quizzes and large group discussion. Final assessments may be drawn from those used throughout healthcare education, including multiple choice questions, short answer questions, practical exams and Objective Structured Clinical Exams.²²⁻²⁴

Flipped classroom use in veterinary education is rarely reported in the literature, and no studies exist of flipped classroom use in veterinary education across international settings. Examples where use of the flipped classroom has been reported in veterinary education include clinical communication²⁵, animal science²⁶, and urinary systems.²⁷ In the study by Moffett and Mill²⁵, use of the flipped classroom technique increased student engagement and enjoyment of learning in classes focused on veterinary clinical communication. Student learning was assessed via multiple-choice exams, and satisfaction was measured using the Course Evaluation Questionnaire (CEQ), a 25-item survey instrument.²⁸ Moffett and Mill²⁵ found that while students enjoyed the flipped classroom instruction more and rated the teaching staff more highly, the traditional classroom instruction led to enhanced academic outcomes. The authors concluded that more investigation is necessary to understand the inter-relationship between student satisfaction and learning, as the skills taught in the course may not have been fully assessed via a

multiple-choice exam. A study comparing student performance in a lecture-based course compared to the same course taught using TBL (as a specific application of the flipped classroom approach²⁷), found no difference in exam scores at the end of the course. However, in this same study, students in the TBL group scored significantly higher than those in the lecture group when the exam was repeated 18 months later. This illustrates how innovative assessment techniques may be necessary to measure the types of enhanced learning expected from flipped classrooms.

The research reported in this paper sought to address the gap in knowledge that exists about the use of the flipped classroom technique in veterinary education internationally. The research questions were:

1. What is the extent of use and familiarity with the flipped classroom technique in veterinary education?
2. What strategies are used for flipping the classroom in veterinary education?
3. What are the perceived benefits and barriers to flipped classroom use in veterinary education?
4. What relationships exist between respondent characteristics and flipped classroom use in veterinary education?

The aim of this research was to establish baseline information about the use of the flipped classroom technique in veterinary education, which can then be used for comparative purposes as educational technologies available to teach students continue to expand.

Materials and methods

This study used a paper-based survey to gather qualitative and quantitative data about flipped classroom use in veterinary education (Appendix 1). The survey was administered at four veterinary education conferences across three continents – the American Association of Veterinary Medical Colleges Annual Conference (AAVMC) and the Veterinary Educator Collaborative (VEC) in the USA, the Australian Veterinary Association Annual Conference (AVA) in Australia, and the VetEd

Symposium (VetEd) in the UK. Participants included teachers and administrators in veterinary schools internationally, with both clinical and non-clinical teachers represented. A total of 165 usable surveys were returned. Non-usable surveys were either left blank, or returned without any demographic information. Not all participants responded to all questions, and some participants included more than one item or theme in their response to a particular question. Thus, the number of responses per question does not always equal 165. The survey distribution procedures ranged from placement on participants' chairs prior to a conference session, to inclusion of a paper copy in conference registration packets. Due to the different distribution mechanisms at each conference, an exact response rate cannot be calculated. The authors estimate that 433 copies of the survey were distributed for completion, which would yield an approximate response rate of 38%. Data collection occurred during the 2014 calendar year and was approved by the Institutional Review Boards of the authors' institutions.

Survey questions asked participants for demographic data such as gender, age, years of teaching experience and country in which they taught, as well as their familiarity with and use of the flipped classroom technique. Participants' views were sought on the benefits and barriers to teaching with the flipped classroom technique, together with the current methods being used to teach with this technique.

Types of activity used were analyzed and grouped into themes by one author (SW) with subsequent discussion and agreement of themes by all authors. Each written response was then assigned to one or more themes. Perceived benefits and barriers were analyzed by two of the authors (JD and RS) to identify initial themes. Subsequently, through an iterative discussion and coding process involving all authors, an overall thematic framework for barriers and benefits was developed. All responses relating to benefits and barriers were then assigned to one or more themes by all four authors. Agreement between three or more of the four authors was used as the baseline for categorizing responses into a particular theme, with 95% overall agreement achieved. In the tables showing individual responses, each response

is identified by a number indicating the participant who gave that response, e.g. P40 = Participant ID Number 40. Descriptive statistics were used to quantify respondent characteristics and to estimate the extent to which qualitative responses were representative of participants as a group.

Results

A total of 165 veterinary faculty and administrators responded to the survey. The gender distribution of participants was 104 (63%) female and 41 (25%) male, with 20 (12%) non-response (NR) to this question. Most participants were from North America ($n = 103$, 62%), with 31 (19%) from the UK and Europe, 13 (8%) from Australia, 6 (4%) from other countries, and 12 (7%) non-response. Fifty-five participants (34%) were less than 45 years old, 51 (31%) between 45 and 54 years old, 50 (29%) at least 55 years old, and 11 (7%) did not indicate an age range. Teaching experience was fairly evenly distributed across six-year increments from 0-24 years, with 29 (18%) of the participants having 0-6 years' experience, 39 (24%) having 7-12 years' experience, 34 (21%) having 13-18 years' experience, 26 (16%) having 19-24 years' experience, 22 (13%) having 25 years or more experience, and 15 (9%) non-response. See Tables 1 and 2.

[Insert Tables 1 and 2 here]

Participants' level of familiarity and extent of current use of the flipped classroom technique are shown in Tables 3 and 4. Participants ($n = 161$) rated their level of familiarity with the flipped classroom technique, using a Likert scale ranging from 1 (Not at All) to 5 (Extremely). Few participants indicated they had not yet heard of flipping the classroom (5%) or rated themselves as 2 out of 5 on the scale (8%). Most participants indicated they were at a 3 (30%) or 4 (40%) on the five-point scale of familiarity, with 15% of participants indicating they were extremely familiar with the flipped classroom technique. Women were more familiar with the flipped classroom technique than men, with 59% of women and 41% of men indicating a familiarity of 4 or 5 on the 5 point scale. Participants' ($n = 156$)

self-reported extent of use of the flipped classroom technique was assessed with a Likert scale ranging from 1 (Not at All) to 5 (Exclusively). Just over half of participants were below the mid-point of this scale, with 32% indicating they did not use the flipped classroom technique at all and 21% rating their use as 2 out of 5 on the scale. Thirty-one percent of participants rated their use as being at the mid-point and 8% rated their use as 4 out of 5. No participants indicated that they used the flipped classroom technique exclusively in their teaching.

[Insert Tables 3 and 4 here]

Of those participants who were familiar with the flipped classroom technique ($n = 156$), most indicated that they had encountered it through colleagues (94 participants, 60%), faculty development activities (76 participants, 49%) or journal articles (68 participants, 44%). Seventy-three participants (47%) indicated they were familiar with the flipped classroom technique through personal experience (either using it or being taught with it), and 32 (21%) through other means such as professional conferences, graduate/post-graduate coursework and internet resources (e.g. YouTube, Khan Academy, TED talks).

The activities used pre-class and in-class by those participants currently teaching with the flipped classroom technique ($n = 100$) are shown in Table 5.

[Insert Table 5 here]

Several benefits to using flipped classroom approaches were perceived by the participants. The most commonly listed benefit was a perception that the flipped classroom technique enhanced learning (94 participants). The ways in which the flipped classroom technique was perceived to enhance learning are detailed in Table 6, including illustrative quotes and the number of responses assigned to each benefit. Comments coded as improving overall engagement addressed factors such as attention, motivation, interest, confidence and feedback. Participants also perceived that the flipped classroom

technique was a better use of time (10 participants; “More efficient use of time in the classroom”, P40), enhanced student-faculty contact (7 participants, “The instructors have more opportunity to directly interact with the students”, P66) and enhanced faculty preparation (2 participants, “Developing 5-15 min videos (the content) requires me to significantly re-evaluate instructional goals”, P79).

[Insert Table 6 here]

Barriers perceived by participants in this study to implementing the flipped classroom technique were categorized as either student-related barriers (87 participants), faculty-related barriers (60 participants), institution-related barriers (50 participants) or unspecified time-related barriers (11 participants). The student-, faculty- and institution-related barriers mentioned by participants are detailed in Table 7.

[Insert Table 7 here]

Discussion

This article reports what is to the authors’ knowledge the first multi-national study investigating use of the flipped classroom technique in veterinary education. The results have revealed participants’ familiarity and extent of use of the flipped classroom technique, together with the activities used and the perceived benefits and barriers to implementation. These can inform decisions by individual faculty and college administrators considering implementing the flipped classroom technique in their curricula.

Although the use of the term ‘flipped classroom’ has become closely associated with the use of educational technologies, the results of this study underscore that faculty may use both ‘old’ and new technologies in the flipped classroom technique. While educational technologies such as voice-over-PowerPoint slides, videos and podcasts may be used for pre-class activities, more traditional methods such as reading journal articles, textbooks or lecture notes can also be used. Similarly, while educational technologies such as clickers, multimedia student presentations and creating videos may be used for in-

class activities, so may traditional teaching methods such as class discussion, group activities and in rounds.

Research in online learning²⁹ and a variety of classroom teaching contexts¹ indicates that the benefit for student learning of the flipped classroom technique is gained not through use of educational technologies *per se*, but through the alignment of learning activities with intended learning outcomes and assessments. This principle, referred to by Biggs and Tang¹ as ‘constructive alignment’, applies across online and face-to-face learning environments irrespective of the teaching methodologies used.^{1,29,32} Appropriate resources must be provided to support implementation of educational technologies in the flipped classroom technique if they are to be used.³⁰ Faculty seeking to use educational technologies to support student learning should also ensure that their products align with the principles of effective multimedia instruction.³¹ These include designing multimedia learning resources so that they omit extraneous details, include cues that highlight the organization of essential material and create opportunities for interactive learning within the multimedia system.³¹

In the present study, a range of benefits were perceived from using the flipped classroom technique by participants in this study, with more than half of the participants ($n = 94$, 57%) perceiving that it enhances learning in the classroom. Prior preparation for class was perceived to enable in-class time to be used for more active learning approaches, such as class discussion, small group work, problem solving and case-based exercises.

These perceived benefits are consistent with prior research. Active learning activities have been linked to better quality learning outcomes for students in a range of disciplines, including in veterinary and animal science²⁶, and other healthcare education contexts such as pharmacology.¹⁸ Research in gross anatomy demonstrated enhanced performance for students participating in a flipped classroom on items requiring higher order thinking skills, such as analysis, but no differences in other types of tasks.²⁰

Other, less tangible benefits of using the flipped classroom technique were perceived by participants in the survey, such as enhanced student-faculty contact and faculty preparation. The relationship between students and their teachers is something that benefits both student learning and faculty satisfaction in their teaching.³² Use of the flipped classroom technique, therefore, has the potential to improve the overall learning and teaching experience of students and faculty in a course, contributing to a culture where active, independent learning and preparation is encouraged and enjoyed.

Both real and perceived barriers to implementing the flipped classroom technique must be addressed to take advantage of these benefits. The responses to the survey in the present study revealed that the main barriers perceived to implementing the flipped learning technique could be categorized into those related to faculty, students and the institution. Faculty-related barriers included finding the time to identify and create independent learning resources for students to use in preparation for class activities. This encompasses both gathering and collating traditional resources such as articles and textbook chapters, as well as the time to create online learning activities if these are to be used.

Prior research indicates that additional technical support to create online learning resources is invaluable for faculty seeking to implement a flipped classroom technique and use these resources for the first time.³⁰ Time must also be found for redesigning in-class activities to include a greater focus on what the student does to learn in class rather than what the lecturer wants to convey. This shift from a lecturer-centered to a student-centered focus for teaching requires both a conceptual change and skill development on behalf of the lecturer.⁵ Since the majority of veterinary educators do not have formal coursework in education, they must engage in continuing professional development to build their repertoire of instructional methods. Forty-nine percent of participants in this study indicated that they had heard of using the flipped classroom technique through professional development courses, 60% through the experiences of others, and 44% through journal articles. For greatest success in training,

however, existing research suggests that faculty development courses must focus on changing teachers' conceptions of their role as an educator as well as the skills required for successfully implementing active learning techniques in the classroom.⁶ Therefore, veterinary schools desiring to improve faculty skill with flipped techniques might consider offering specific faculty development in this area.

Student-related barriers perceived to implementing the flipped classroom technique in a veterinary context by the participants in this survey included lack of student time to undertake preparation for class, and student resistance to the flipped classroom technique. These concerns may be somewhat related to the institutional barriers identified by some participants, regarding the extent to which the flipped classroom technique can be implemented at a programmatic level.

Prior research indicates that successful implementation of the flipped classroom technique requires consideration of students' workload, both in the course that is flipped and other concurrent courses in the degree program.^{1,6} Several participants in the present study flagged that flipping one course was generally acceptable with regards to workload, but that flipping several at the same time would be unmanageable for students. A potential explanation for this assertion is that even when the flipped classroom simply re-arranges students' workload, so that preparation and study time are front-loaded, it still leads to an increase in overall workload by prompting students to actually do the out-of-class work at the relevant time in the semester, when they may have either omitted or deferred doing this work otherwise. This may be particularly true for students from non-traditional education backgrounds who have significant work or caregiving responsibilities outside class.³³

Lack of student preparation for class was a particular barrier identified by participants in the present study. Quizzes based on preparatory work and administered prior to or at the start of class can be used to increase the likelihood that students will prepare for class. A formalized method for this is found in the Individual Readiness Assurance Test which has been used in TBL at the start of in-class

activities.³⁴ The results of these tests may accumulate towards students' final grade in the course, providing additional motivation for preparatory learning. TBL has frequently been shown to benefit learning in medical sciences education; Fatmi et al.²¹ found that 10 of 14 studies showed improvement in learning due to TBL implementation, with four showing no difference. A study of second-year medical students³⁵ showed that TBL benefited both lower- and higher-achieving students, with greater learning gains demonstrated by lower-achieving students.³⁵ These results suggest that inclusion of a formal pre-class test on preparatory material could be a useful component of a flipped classroom approach in general.

It is important to consider the limitations of the present study when seeking to apply its results. This study represents an initial exploratory study into the use of and familiarity with the flipped classroom technique among veterinary educators. The sample size is relatively small, and the participants represented a convenience sample of audience members at four international veterinary education conferences. As such, it is possible that their use of the flipped classroom technique was not representative of the broader veterinary educator population. It is possible that educators attending teaching development and administrative conferences in veterinary education are more likely to be familiar with and use the flipped classroom technique than the general population. It is also possible that participants had greater interest in, use of and success with the flipped classroom than non-participants. Our study does not specifically address the impact of students' prior educational experience on perceptions of effectiveness of the flipped classroom. Whilst the majority of participants were from North America, the international demographic of participants is representative of a range of veterinary educational systems, from 4-year professional degrees (post-baccalaureate), to six-year undergraduate (post-secondary) programs.

A fruitful area for future research could be to explore the links between use of the flipped classroom technique and students' assessment outcomes, especially in courses that require clinical reasoning. There has been limited research to date showing that use of the flipped classroom technique is positively correlated with improvements in assessment results in veterinary education, and none showing a long-term positive impact on student learning outcomes in clinical settings. Given the work involved in implementing the flipped classroom technique, especially if this is to be done curriculum-wide, it is important that the long-term benefits of this method be established prior to major curriculum review and implementation. Researchers might also seek to explore potential differences in flipped classroom use by geographical region or gender.

Conclusion

The results of this study reveal that most participants in this study were familiar with the flipped classroom technique, and heard of it through colleagues, faculty development activities, and journal articles. Most participants reported that they perceived the flipped classroom technique benefited student learning. Some also commented that it enhanced student-faculty interaction and improved lecturer preparation. Fewer participants, though, were using the flipped classroom technique extensively in their teaching. Many reported student-, faculty- and institution-related barriers to implementation.

Administrators and educators seeking to improve students' preparedness for practice by increasing use of the flipped classroom technique in veterinary education need to consider and address these challenges if they wish to use this technique to enhance student learning. This includes motivating student preparation for class, for example by using quizzes based on preparatory material, and carefully monitoring and adjusting student workload to support engagement in the flipped classroom technique.

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Tables

Table 1 Participant demographic information by country in which survey participants were teaching

Country of Teaching	N	Gender			Conference Attended				Age Group (years)										
		Male	Female	NR	AAVMC	AVA	VEC	Vet Ed	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	NR	
Australia	13	3	10			13				1		5	4	1		2			
USA	99	29	64	6	17		82		1	9	11	7	17	14	21	12	6	1	
Canada	4	2	2		1		3				1	1	1		1				

UK	26	4	19	3	3		4	19	3	5	6	4	6	2				
Europe	5	1	3	1	1		1	3	1				2	2				
Other	6	1	5		1		2	3	1	2	1	1		1				
NR	12	1	1	10	5	3	2	1					1	1				10
Total	165	41	104	20	28	16	94	27	1	15	19	20	27	24	28	14	6	11

Table 2 Years of teaching experience by country in which survey participants were teaching

Country of Teaching		Years of Teaching Experience									
	N	0-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25+	NR
Australia	13	1	4	2	3	1		1		1	
USA	99	10	6	9	17	14	6	9	8	17	3
Canada	4			1		1		1		1	
UK	26	2	2	2	3	7	4	3	2	1	
Europe	5			2		1				1	1
Other	6	1	3							1	1
NR	12								2		10
Total	165	14	15	16	23	24	10	14	12	22	15

Table 3 Familiarity with and extent of current use of the flipped classroom technique by country in which survey participants were teaching

Country of Teaching	N	Level of Familiarity with Flipping (1 = not at all, 5 = extremely)						Extent of Current Use of Flipping (1 = not at all, 5 = exclusively)					
		1	2	3	4	5	NR	1	2	3	4	5	NR
Australia	13		1	5	4	3		4	4	4	1		
USA	99	5	7	31	41	13	2	32	18	30	8		10
Canada	4		1	2	1			3	1				
UK	26	4	3	6	8	4	1	9	7	9	1		
Europe	5			1	4			1		1	3		
Other	6		1	2	1	2		1	2	2	1		
NR	12			2	7	2	1	3	3	5			1
Total	165	9	13	49	66	24	4	53	35	51	14		11

Table 4 Familiarity with and extent of current use of flipped classroom technique by gender

Gender	N	Level of Familiarity with Flipping (1 = not at all, 5 = extremely)						Extent of Current Use of Flipping (1 = not at all, 5 = exclusively)					
		1	2	3	4	5	NR	1	2	3	4	5	NR
Male	41	4	4	15	13	3	2	15	11	13	0		2
Female	104	4	9	30	44	17	0	34	19	31	12		8
NR	20	1		4	9	4	2	4	5	7	2		2
Total	165	9	13	49	66	24	4	53	35	51	14		12

Table 5 Pre-class and in-class activities used by those currently teaching with the flipped classroom technique ($n = 100$)

Type of activity used	Examples	Number of Responses
Pre-class activities		
Review material (not specified)	Not specified	27
Review online content	PowerPoint with audio/lectures, videos, websites, podcasts	26
Active learning preparation	MCQs/quizzes, scenarios/cases, reflective assignment, group activities, wiki site creation	16
Review paper-based material	Journals, worksheets, data sets, lecture notes	12
In-class activities		
Class discussion	Discussion, explanation and clarification, Q&A session	21
Interactive student engagement in specified small group activities	Clickers, student presentations, group activities, rounds, jigsaw, journal club, video creation, tutorials	20
Case-based	Problem-solving/case-based sessions	16
Labs/Practicals	Labs, practicals	9
Active learning (activities not specified)		8

Table 6 Ways in which the flipped classroom technique was perceived by survey participants to enhance learning ($n = 94$)

Category	Illustrative quotes (Participant ID Number)	Number of Responses
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Increases active learning in the classroom	Increased student engagement with material that promotes deeper learning. (P4); They learn while doing which engages them. (P66)	44
Improves overall engagement	These activities are engaging and help with motivation. (P126)	14
Generally helps learning/understanding	... deeper understanding and longer-term retention of concepts than a passive lecture. (P106)	17
Allows peer teaching/teamwork	... peers help to create an outstanding learning environment. (P103)	10
Provides opportunities to apply content	They can use the material covered in the course to apply to clinical cases. (R83); Practical exposure to theoretical ideas. (P151)	20
Promotes self-directed learning	They become more in control of their learning and finding resources independently. (P168)	9
Encourages student preparation	If they do the reading, they get more out of in-class time. (P74)	19
Improves exam preparation/scores	It opens the floor to questions or misconceptions before the exam. (P83)	4

Table 7 Barriers perceived by survey participants to implementing the flipped classroom technique

Category	Illustrative quotes (Participant ID Number)	Number of Responses
Student-related barriers (87 participants)		
Lack of student time for activities	If everyone does it, the amount of pre-class or outside work could be overwhelming. (P92); Needs to be carefully integrated into curriculum as student time must be respected. (P149)	45
Student lack of engagement	Getting students to read the material before class was a challenge. Also, some students participated much more than others. (P159)	30
Student resistance	Resistance from some students (want and expect you to teach in traditional ways). (P24); Students resent lots of change or different strategies for teaching and assessment within a large course, and are very accustomed to lecture format. (P104); Students are often reluctant to give up “passive learning”. (P162)	24
Faculty-related barriers (60 participants)		
Increase in faculty workload	Time to prepare pre-reading/resources and development of relevant/engaging application activities. (P64)	42

Faculty resistance unrelated to workload	Getting faculty to buy into the concept that they don't have to present everything in their content area. (P154)	23
Institution-related barriers (50 participants)		
Resources, training and logistics	Technology to produce good videos and online content. (P18); Educating staff and students to use it, engage in it and understand benefits. (P61); Configuration of classroom or learning space. (P65)	34
Curriculum design	Our current curriculum does not allow the flexibility in regards to scheduling. (P125)	15
Institutional support, culture and governance	The administration (and promotion/tenure, in some cases) perspective that “instruction” equals presentation of information by the instructor rather than enhancement of long-term retention and student self-determination and responsibility for their own learning. (P78); Changing the institutional “culture” of learning. (P124)	6
Unspecified time-related barriers (11 participants)		
Unspecified time-related barriers	Time. (P68); Involvement of time/brainpower. (P58); Time involved. (P80)	11

Appendix 1 Flipped Classroom survey

'Flipped Classroom' Use in Veterinary Education

For the purposes of this survey, we are defining 'flipped classroom' as:

An instructional approach where students engage in significant pre-class preparation to become familiar with the concepts to be mastered. Common formats for pre-class preparation may include watching pre-recorded lectures, engaging in online activities or reading textbook chapters. Classroom time is then devoted to active learning, where students engage with the material through exercises such as problem-solving, discussion and quizzes.

- | | Not at all | | Extremely | | |
|--|------------|---|-----------|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 1. Please rate your familiarity with the flipped classroom technique as defined above: | | | | | |

If **you are familiar** with this technique, where have you encountered it? (please mark all that apply)

- ☐ Journal articles ☐ Colleagues ☐ Staff development courses ☐ Personal experience ☐ Other (please describe)

- | | Not at all | | Exclusively | | |
|--|------------|---|-------------|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 2a. Please rate the extent to which you currently use the flipped classroom technique: | | | | | |

- 2b. If **you are currently using** the technique, please describe the activities you are using:

What benefits do these activities have for students in your experience?

- 2c. If **you are not currently using** the technique, are you interested in pursuing these activities in the future?

Yes / No

Why or why not?

3. What do you perceive are the biggest barriers to implementing the flipped classroom technique?

5. Please provide the following information so we can categorize responses:

Country in which you teach: Australia NZ USA Canada UK Europe Other

Years of teaching experience: 0-3 4-6 7-9 10-12 13-15 16-18 19-21 22-24 25+

Academic/Faculty Rank (e.g. Associate Professor): _____

Permanent/Tenured/Tenure-track employment: Yes No

What **percentage of your classroom teaching** occurs at each stage of the curriculum?

_____ Pre-clinical/basic
sciences (e.g. anatomy,
physiology)

_____ Para-clinical (e.g.
pathology, parasitology)

_____ Clinical (e.g.
medicine, surgery)

What **percentage of your job duties** are allocated to each of the following?

_____ Teaching

_____ Research

_____ Clinical

_____ Administration

Gender: Male Female

Age: 25-29 30-34 35-39 40-44 45-49 50-54 55-59 60-64 65+